

# SMALL SYSTEMS MARKET OPPORTUNITIES

INPUT



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SMALL Systems Market Opportunities

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SMALL SYSTEMS MARKET OPPORTUNITIES

PREPARED FOR:

TRW, INC.

FEBRUARY 1978

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## SMALL SYSTEMS MARKET OPPORTUNITIES

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## I INTRODUCTION





## I INTRODUCTION

### A. PURPOSE

- It is the intent of this study to structure the domestic mini/microcomputer market through 1982 with due regard for those forces that are expected to shape this market in the future. An analysis of both the realized and potential market, in addition to a discussion of the competitive environment, is to be presented. The preceding is formulated in order to identify possible market opportunities and related strategies that may permit TRW to develop a major line of business yielding in excess of \$200 million by the mid-1980s with a greater than 15% return on investment (ROI).

### B. RESEARCH AND METHODOLOGY

- The research for this program was divided as follows:
  - Analysis of available minicomputer, small business and microcomputer market, product and competitive information.
  - Supplemental work with outside sources deemed by INPUT to be reliable for purposes of cross-checking and verifying the above information.

- Formulation of a series of scenarios consistent with the above information and suitable for presentation to TRW in satisfaction of the stated purpose of the study.



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## II EXECUTIVE SUMMARY





## II EXECUTIVE SUMMARY

### A. CONCLUSIONS

- The potential market for U.S. minicomputer and small business computer (SBC) systems (excluding the government market) is currently at about 1.25 million units and is projected to grow to approximately two million units by 1982.
  - Approximately 75% of this potential market is concentrated in the manufacturing and distribution industries.
- Shipments to the above market are valued at \$2.15 billion in 1977 and are projected to grow at about a 25% annual compound growth rate to a \$7.0 billion level in 1982.
  - The SBC portion of the 1982 projected market (less government) will be at a \$2.2 billion level.
- Current potential market penetration is believed to be about 6% and is not expected to reach the 20% level until beyond the 1982 forecast period.
- The fastest growing portion of this total market by application is the business EDP portion which is expected to ship 72% of the 190,000 units projected for 1982.

- Eleven specific industry segments requiring general business data processing systems are projected to grow in excess of 300% from 1972 to 1982.
- The Distribution, Other Services, and Transportation and Utilities industrial sectors represent the fastest growing segments over the forecast period and offer a market size in 1982 that is sufficiently large such as to be of potential interest in market strategy formulation.
- Major driving forces spurring the growth of these markets include:
  - Capital spending.
  - Increasing acceptance of the distributed processing concept.
  - Problems associated with acquiring and retaining skilled personnel.
  - Technology driving hardware and eventually software costs down.
  - Increased communications requirements.
- IBM represents a driving force unto itself and the Series/1 introduction of approximately 18 months ago is certainly worthy of that characterization.
  - U.S. minicomputer shipments are projected to accelerate by approximately 8% as a result of IBM's market entry.
- INPUT regards the Series/1 introduction as part of a larger IBM strategy to further long-term goals in consumer, communications, and networking applications.
- From a 2% share of the worldwide minicomputer market in 1977, the Series/1 is expected to achieve a 16% share in 1981 with a value of \$1.2 billion.



- The Series/I represents a very price/performance competitive product with similar offerings from DEC, Data General, and Hewlett-Packard.
- All intelligence based products are marketed to the end user by a variety of distribution channels which, when taken together, comprise a complex array of alternatives.
- As software may increasingly be replaced by hardware, so then may traditional systems or software houses be replaced by electronics or traditional "components" distributors.
- International sales comprise 30-35% of the revenue base of major suppliers.
- Smaller competitors are scrambling to develop a larger market presence in Europe while major European companies appear to be accelerating acquisition strategies for both micro and minicomputer companies in the U.S.
- Semiconductor technology, largely through ongoing advances in very large scale integrated (VLSI) circuits, will continue to drive the cost of memory and logic products down.
- Accordingly, technology is expected to further facilitate the transparency of intelligence based systems to the end user as the economic incentives to more efficiently program software diminish with the advent of firmware.
- The current mini/microcomputer and SBC competitive environment numbers over 100 companies and is perceived by INPUT to be moving toward oligopoly in the post-1980 time frame.
- Significant new market entrants over the forecast period include such traditional semiconductor companies as Texas Instruments, Intel, and National Semiconductor with the Japanese to be reckoned with in the next 10 years.

- Severe price competition is expected at the low end of the intelligence based market (average system selling prices below \$20,000).
- Several opportunity scenarios were examined during the course of this study and appear to offer the potential for integration within a market penetration strategy. They are related to:
  - Human resource utilization and reporting.
  - Short-term increasing maintenance and diagnostic requirements.
  - Computer aided design and drafting.
  - Opportunities in structuring a credit resource through TRW's participation in retail, credit, and banking applications.

## B. RECOMMENDATIONS

- As attractive as are a number of the markets delineated in this study, every effort must be made to avoid market segments either dominated by entrenched giants and/or potentially subject to aggressive price competition.
- Emphasis should be placed on the manipulation and management of data with particular attention paid to the role communications will play in the next decade. INPUT regards communications as the "glue" that will hold the EDP industry together and enable its dynamic growth in the years ahead.
  - Every effort should be made to avoid or minimize applications programming as a key strategy element. The concept is dated and is being pursued by many firms.

- Special purpose solutions to particular industry problems should be stressed and configured by means of unique combinations of hardware, software, and communications elements. "Number crunching" or calculations oriented solutions are no longer unique and are in wide use.
- A strategy based on product differentiation through value added methods continues to have merit. Every effort should be made to avoid high volume, commodity oriented products or markets which offer the spectre of price and margin pressures.
- One of TRW's major strengths is its diverse maintenance base which INPUT recommends be exploited to the fullest in the short term. Increasing utilization of high reliability solid state and related manufacturing methods are expected to compromise this strength over the longer term.
- TRW is urged to analyze several functional product opportunities that transcend industry or application boundaries. These include human resource reporting, computer aided design and drafting, remote maintenance and diagnostic services and a retail credit resource. As part of this recommended analysis, TRW is encouraged to:
  - Focus in and refine the industry/application market projections formulated by INPUT in this study.
  - Establish product/service specifications suitable to the market segment in question.
  - Develop a market entry strategy with due consideration for the obvious merger, acquisition, internal development or joint marketing/manufacturing options. INPUT wishes to impart a sense of time urgency with regard to the acquisition alternative as a result of what we perceive to be an accelerating trend toward the utilization of this option.



- Consider distribution and pricing strategies that may be conceivably employed in such a potential market entry.
- Define and analyze actual and potential competition expected to be encountered in each of these areas.

### III THE MARKET FOR MINICOMPUTERS AND SMALL BUSINESS COMPUTERS





### III THE MARKET FOR MINICOMPUTERS AND SMALL BUSINESS COMPUTERS

#### A. DETERMINING MARKET POTENTIAL

- In an effort to structure the U.S. minicomputer and SBC market, INPUT analyzed both the potential size of the domestic market as well as actual demand by industry segments. The government sector, which INPUT estimates to be 15% of the total market, was excluded due to the short time available for the study.
- The U.S. economy was divided into 15 industry sectors covering both the manufacturing and services segments (see Exhibit III-1). Employment statistics in each of these sectors were derived from the 1974 County Business Patterns report. These statistics covered those businesses with 20 or more employees; a level that INPUT believes is capable of justifying an intelligence based system. A uniform 4% annual growth rate in the labor force of each segment was assumed in order to bring these statistics to 1977 levels (see Column A - Exhibit III-1).
- INPUT assumed a figure for the number of employees capable of utilizing an intelligence based system in each of these sectors. Our assumptions were based on the following variables:
  - Type of industry, i.e., manufacturing or service.

## EXHIBIT III-1

POTENTIAL U.S. MINICOMPUTER AND SBC SYSTEM MARKET (K UNITS)

(1977 - 1982)

(EXCLUDES GOVERNMENT: FEDERAL, STATE, LOCAL)

INDUSTRY	A	B	C	D	E	F
AGRICULTURE	.05	250	.2	.06	-	1.0
MINING	.65	200	3.3	.79	-	5.0
CONSTRUCTION	2.75	150	18.3	3.35	100	33.0
MANUFACTURING, DISCRETE	11.25	30	375.0	13.69	25	560.0
MANUFACTURING, PROCESS	10.35	30	345.0	12.59	25	510.0
WHOLESALE DISTRIBUTION	3.10	50	62.0	3.77	25	150.0
RETAIL DISTRIBUTION	8.05	50	161.0	9.79	35	280.0
FINANCE	1.10	50	22.0	1.34	25	54.0
HEALTH	3.25	50	65.0	3.95	35	111.0
HOTELS	.75	100	7.5	.91	60	15.0
EDUCATION	.90	50	18.0	1.09	35	31.0
INSURANCE	1.30	50	26.0	1.58	30	53.0
LEGAL/ ACCOUNTING	.20	50	4.0	.24	40	6.0
TRANSPORTATION	1.80	30	60.0	2.19	25	88.0
UTILITIES	2.00	30	66.7	2.43	25	100.0
TOTALS	47.50	38 (AVERAGE)	1,234.0	57.77	29 (AVERAGE)	1,997.0

EXHIBIT III-1 (CONT'D.)

POTENTIAL U.S. MINICOMPUTER AND SBC SYSTEM MARKET (K UNITS)

(1977 - 1982)

(EXCLUDES GOVERNMENT: FEDERAL, STATE, LOCAL)

LEGEND

A = NUMBER OF EMPLOYEES IN ESTABLISHMENTS WITH MORE THAN 20 EMPLOYEES  
IN 1977 (MILLIONS)\*

B = POTENTIAL: NUMBER OF EMPLOYEES/MINICOMPUTER SYSTEMS BY INDUSTRY  
(1977)

C = POTENTIAL: MINICOMPUTER DRIVEN SYSTEMS (K) FOR 1977 ( $A \div B$ )

D = NUMBER OF EMPLOYEES IN ESTABLISHMENTS WITH MORE THAN 20 EMPLOYEES  
IN 1982 (MILLIONS)\*\*

E = POTENTIAL: NUMBER OF EMPLOYEES/MINICOMPUTER SYSTEMS BY INDUSTRY  
(1982)

F = POTENTIAL: MINICOMPUTER DRIVEN SYSTEMS (K) FOR 1982 ( $D \div E$ )

\*REFERENCE: 1974 COUNTY BUSINESS PATTERNS WITH 4% ANNUAL GROWTH RATE

\*\*4% ANNUAL GROWTH RATE



- Physical concentration of employees (factory as opposed to a farming establishment).
- Average wage rates in each industry.
- In general, industries with relatively high wages and large concentrations of employees and which could benefit from the productivity benefits to be derived from intelligence based products, yielded a higher number of minicomputers or SBC systems per employee. This resulted in Column B in Exhibit III-1.
- Dividing Column B by Column A, therefore, yielded a potential number of systems for each industry segment which totaled 1.234 million systems in 1977.
- The same methodology was used in deriving the 1982 market potentials. A 4% growth in the work force across all industry sectors was assumed through the forecast period.
- Column E in Exhibit III-1 shows a general increase in the number of intelligence based systems per employee in 1982. This results from the following assumptions:
  - Wages continuing to increase at a rate that is faster than individual employee productivity gains.
  - Increased management attention to asset utilization and return on investment.
  - Price/performance improvements in systems capabilities that serve to continue to expand an elastic market.
- Accordingly, INPUT projects a compound annual growth rate in the potential market for minicomputer and SBC systems of about 10% over the next five years approaching a market potential of almost two million units.

- The total 1977 worldwide market for minicomputer systems is estimated to be \$2.6 billion with about 77,000 systems being shipped. The U.S. market represents about 70% of this total and is projected to grow at a 24% (see Exhibit III-2) average annual growth rate through 1982 to reach a \$5.6 billion level. INPUT regards this 24% growth projection to represent a conservative estimate.
- The total domestic 1977 market for SBC systems is valued at \$700 million with a projected growth rate of 30% per year through the forecast period. 1982 sales are thus projected to reach a \$2.6 billion level. This projected growth rate is also regarded as conservative by INPUT.
- All of the preceding market figures have been corrected to exclude the government market which is assumed to represent 15% of the total. Total non-government market growth from 1977-1982 is, therefore, conservatively estimated at a 26% compound rate and will reach a \$7.0 billion level in 1982.
- Exhibit III-3 reconciles the potential market estimates with INPUT's expectations for actual market shipments through the 1977-82 forecast period. Column E derives a percentage figure for the served portion of the potential market. It effectively indicates that only 10% of the potential domestic market (excluding government) will begin being served by 1980 and beyond. These figures seem to correlate well with other INPUT information including:
  - Oral comments from senior management at DEC, Data General, and IBM to the effect that their current perceived market penetration was of the order of 5-10%.
  - The very rapid rate of market growth over the last several years (approximately 40% per year) suggesting limited market penetration.

EXHIBIT III-2

ANNUAL SHIPMENTS (U.S.) FOR MINICOMPUTER AND SBC SYSTEMS

(K UNITS/\$ BILLION)

MARKET SEGMENT	1977	1978	1979	1980	1981	1982	CUMULATIVE
(A) SMALL BUSINESS COMPUTERS (MINI BASED: 30% AAGR; \$30-34K EACH)	22/0.70	28/0.90	37/1.20	48/1.50	62/2.00	80/2.60	277/8.90
(B) OTHER MINICOMPUTER SYSTEMS (24% AAGR; (\$34-40K EACH)	50/1.80	65/2.25	80/2.80	100/3.60	120/4.70	145/5.60	560/20.75
(C) TOTAL SHIPMENTS. (A+B)	72/2.50	93/3.15	117/4.00	148/5.10	182/6.70	225/8.20	837/29.65
(D) TOTAL LESS ALL GOVERN- MENT SHIPMENTS (CX85%)	61/2.15	79/2.65	99/3.40	126/4.35	155/5.70	191/7.00	711/25.25

EXHIBIT III-3

U.S. MINICOMPUTER AND SBC SYSTEMS MARKET PENETRATION

EXCLUDING GOVERNMENT (FEDERAL, STATE, CITY) (UNITS)

YEAR	(A) GROSS MARKET POTENTIAL (K)	(B) ANNUAL SHIPMENTS (K)	(C) YEAR END INSTALLED BASE (K)	(D) (A-C) UNFILLED NEED (K)	(E) (B÷D) MARKET PENETRATION (%)
1977	1,235	60	210	1,025	5.9
1978	1,360	80	290	1,070	7.5
1979	1,500	100	390	1,110	9.0
1980	1,650	125	510	1,140	11.0
1981	1,800	155	665	1,135	13.7
1982	2,000	190	855	1,145	16.6
		710			



## B. MARKET CHARACTERIZATION BY APPLICATION AND INDUSTRY SECTOR

- Exhibit III-4 breaks down minicomputer shipment projections by four major applications areas including:
  - Problem solving or computational functions to be found in scientific or engineering applications as well as general timesharing.
  - Automation of such functions as testing and monitoring and the control of manufacturing processes, traffic lights, etc.
  - Large system support functions may find minicomputers used in communications applications complementary to large EDP installations. (For example, these include communications preprocessors and message switchers as well as equipment peripheral to the mainframe itself in such applications as data entry and conversion, intelligent terminals, graphics, and printers).
  - General business EDP is arbitrarily defined to include all minicomputer systems below the mainframe class of machine that may be used in a business application.
- Recognizing the strong market relationship between SBC systems and the general business EDP market, we have combined both in the lower portion of Exhibit III-4. It is interesting to note that 72% of projected unit shipments in 1982 will be to this business oriented EDP market.
- Exhibit III-5 apportions the 1977 and 1982 minicomputer and SBC markets among the 15 major industry segments identified earlier in this report. These are further consolidated into six industry groups presented in Exhibit III-6. Key conclusions that may be drawn from this exhibit include:

## EXHIBIT III-4

## SHIPMENTS FOR OEM MINICOMPUTERS AND

## SBC SYSTEMS BY APPLICATION (K UNITS) - U.S./NON-GOVERNMENT

APPLICATION	1977	1978	1979	1980	1981	1982
(A) PROBLEM SOLVING	8 (20%)	11 (20%)	13 (20%)	15 (15%)	16 (10%)	16 (10%)
(B) AUTOMATION AND CONTROL	4 (10%)	6 (10%)	7 (10%)	9 (10%)	10 (10%)	12 (10%)
(C) LARGE SYSTEM SUPPORT	13 (30%)	17 (30%)	18 (25%)	19 (25%)	22 (25%)	25 (20%)
(D) GENERAL BUSINESS EDP	17 (40%)	21 (40%)	30 (45%)	42 (50%)	54 (55%)	69 (60%)
TOTAL	42	55	68	85	102	122
(E) SMALL BUSINESS COMPUTERS (SBC) (MINI-BASED)	18	25	32	40	53	68
TOTAL (NET OF GOVERNMENT)	60	80	100	125	155	190

## RECAST :

(1) PROBLEM SOLVING	8 (13%)	11 (13%)	13 (13%)	15 (12%)	16 (10%)	16 (8%)
(2) AUTOMATION AND CONTROL	4 (7%)	6 (8%)	7 (7%)	9 (7%)	10 (6%)	12 (6%)
(3) LARGE SYSTEM SUPPORT	13 (22%)	17 (21%)	18 (18%)	19 (15%)	22 (14%)	25 (13%)
(4) BUSINESS EDP	35 (58%)	46 (58%)	62 (62%)	82 (66%)	107 (69%)	137 (72%)
NET SHIPMENTS	60	80	100	125	155	190

EXHIBIT III-5

MINICOMPUTER AND SBC SYSTEM SHIPMENTS

BY INDUSTRY-U.S./NON-GOVERNMENT

(1977 AND 1982)

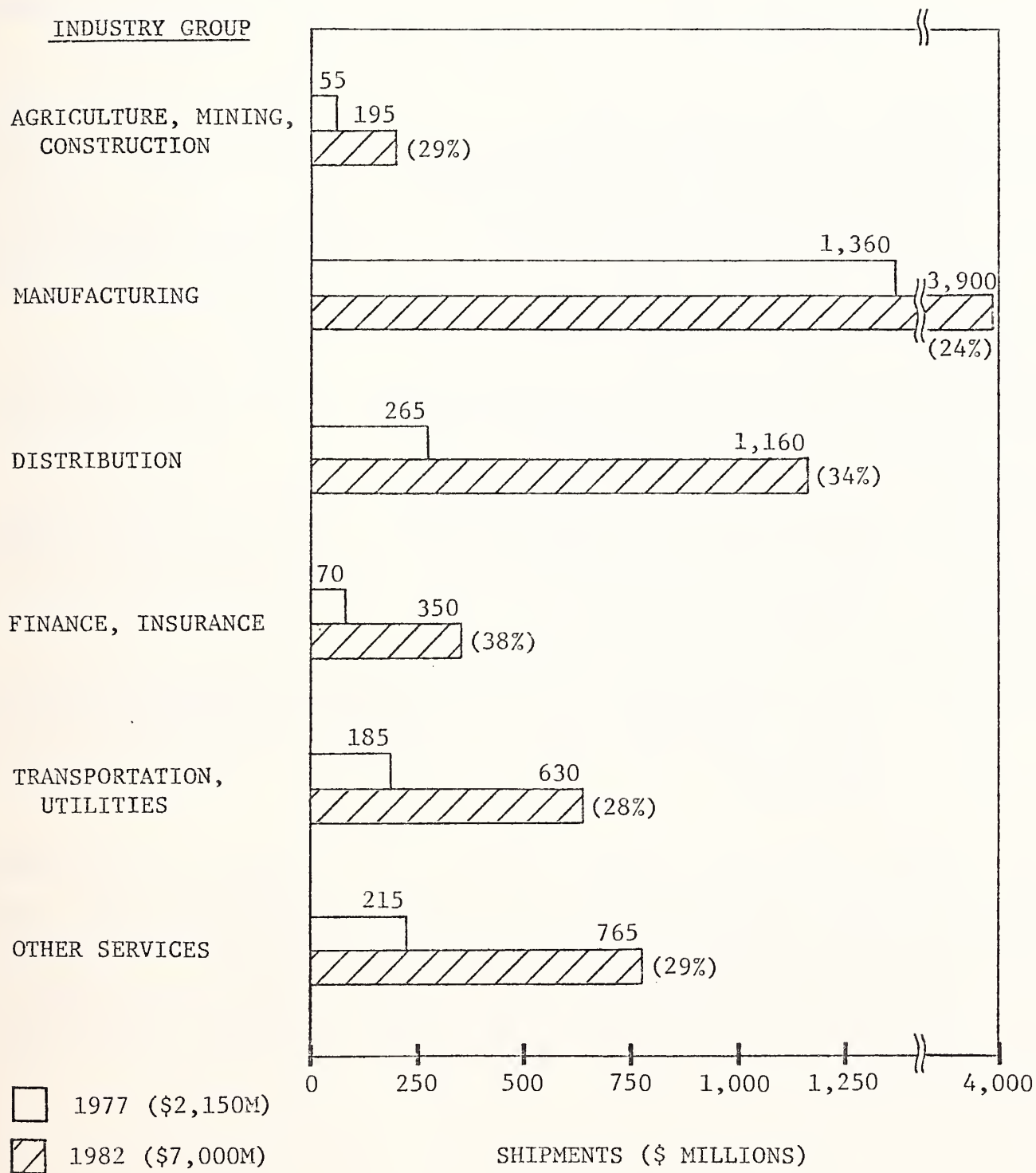
INDUSTRY	1977		1982	
	UNITS (K)	\$ (MILLIONS)	UNITS (K)	\$ (MILLIONS)
(1) AGRICULTURE	-	-	-	-
(2) MINING	<1	4-6	<1	12-18
(3) CONSTRUCTION	1	40-60	3	150-200
(4) MANUFACTURING, DISCRETE	20-25	700-850	55-60	2,000-2,200
(5) MANUFACTURING, PROCESS	15-20	500-700	50-55	1,600-2,000
(6) WHOLESALE DISTRIBUTION	1-2	80-120	8-10	400-450
(7) RETAIL DISTRIBUTION	4-6	150-200	20-25	700-750
(8) FINANCE	1	30-50	3-4	150-200
(9) HEALTH	2-3	90-130	8-12	420-480
(10) HOTELS	<1	8-12	1	40-60
(11) EDUCATION	1-2	70-110	3	220-260
(12) INSURANCE	1	20-40	4	150-200
(13) LEGAL/ACCOUNTING	<1	4-6	<1	20-30
(14) TRANSPORTATION	1-2	60-90	9-10	250-300
(15) UTILITIES	3-4	90-130	9-12	325-375
TOTALS	60	2,150	190	7,000

EXHIBIT III-6

MINICOMPUTER AND SBC SYSTEM SHIPMENTS,

BY INDUSTRY GROUP-U.S./NON-GOVERNMENT

(1977 AND 1982, \$ MILLIONS)



AAGR



- Manufacturing and distribution will together continue to take the major share of minicomputer and SBC products with a greater than 70% share of the 1982 market.
  - The Distribution, Other Services, and Transportation and Utilities industrial sectors represent the fastest growing segments over the forecast period. Their projected market sizes in 1982 are sufficiently large to be of potential interest in market strategy formulation.
- Similarly, Exhibit III-7 breaks down the 1977 and 1982 projected markets by applications area which have been discussed earlier in this report. INPUT has further broken down these applications areas for the purpose of highlighting several sectors that appear to be of particular interest. These include particularly the communications and design/drafting sectors.
- Exhibit III-8 consolidates the above information into a bar chart representation offering the following highlights:
- Not surprisingly, the Business EDP sector will demand close to 60% of the 1982 market and represents the fastest growth segment at a 32% compound growth rate.
  - The communications portion of the Large System Support sector offers about a \$600 million market in 1982 and a compound growth rate of about 25%.
- Finally, Exhibit III-9 presents a matrix of the 15 industry segments broken down into eight applications many of which cross industry boundaries. Each cell within the matrix represents a minicomputer and/or SBC system market to which INPUT has assigned one of three asterisks. These asterisks reflect the relative rate of growth of that particular market through the 1977-82 forecast period.

## EXHIBIT III-7

## MINICOMPUTER AND SBC SYSTEM SHIPMENTS

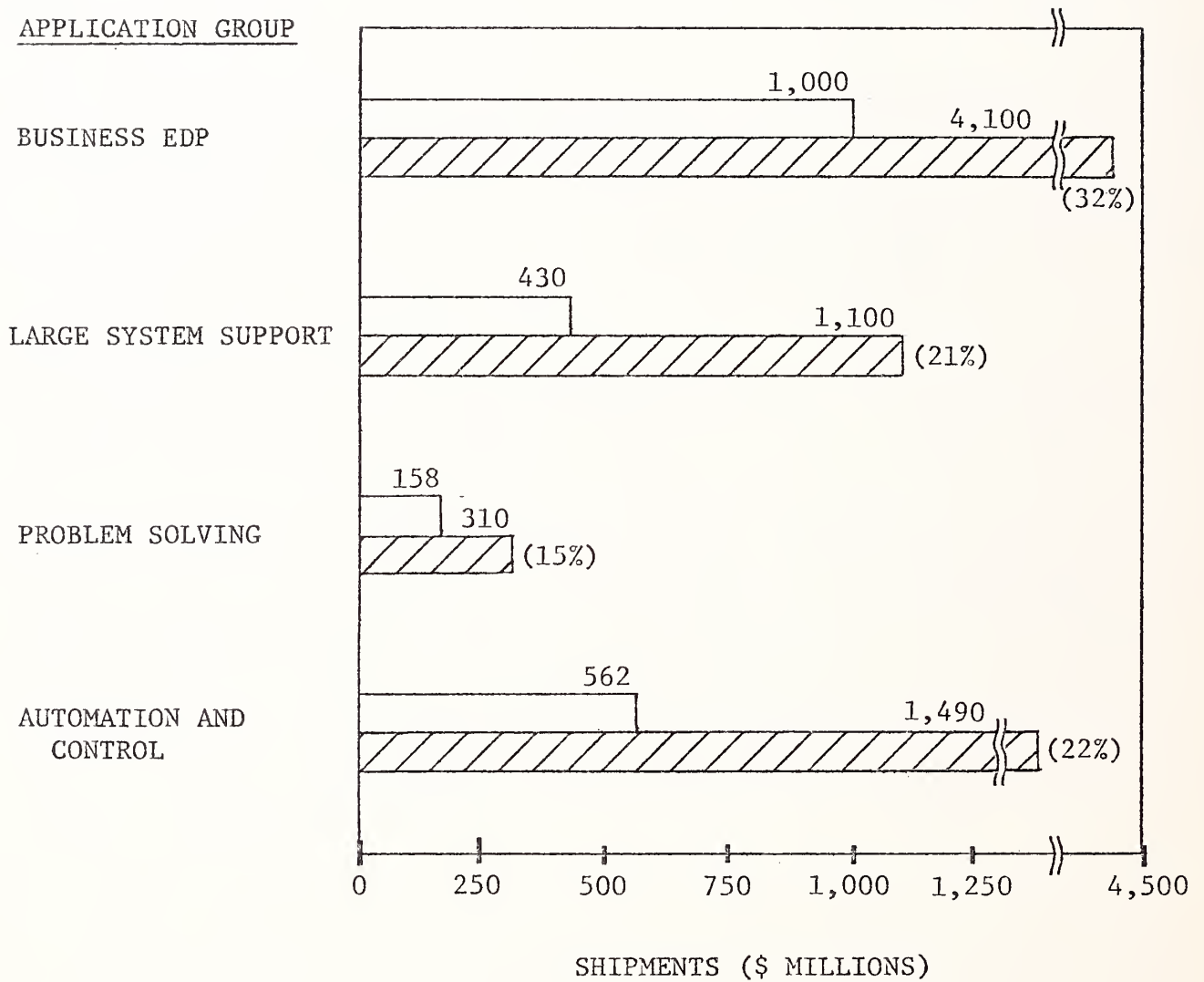
BY APPLICATION-U.S./NON-GOVERNMENT

(1977 AND 1982)

APPLICATION	1977		1982	
	UNITS (K)	\$ (MILLIONS)	UNITS (K)	\$ (MILLIONS)
(A) GENERAL BUSINESS D.P.	30-40	800-1,200	125-150	4,000-4,200
(B) COMMUNICATIONS	3-5	200-225	10-15	500-700
(C) DESIGN/DRAFTING	>1	40-60	3-5	150-250
(D) EDP SUPPORT	4-6	200-225	10-15	400-600
(E) INDUSTRIAL CONTROL	10-15	240-280	25-50	600-700
(F) INSTRUCTIONAL	1-3	100-120	3-5	200-250
(G) SCIENTIFIC/LAB	5-8	225-275	15-25	600-650
(H) SPECIAL DATA ACQUISITION/CONTROL	1-2	40-60	3	75-125
TOTALS	60	2,150	190	7,000

# EXHIBIT III-8

## MINICOMPUTER AND SBC SYSTEM SHIPMENTS BY APPLICATION GROUP-U.S./NON-GOVERNMENT (1977 AND 1982, \$ MILLIONS)



☐ 1977 (\$2,150M)  
☒ 1982 (\$7,000M)  
 (AAGR)

## EXHIBIT III-9

GROWTH MATRIX OF MINICOMPUTERS AND SBC SYSTEM SHIPMENTS BY INDUSTRY AND  
 APPLICATION - U.S./NON-GOVERNMENT  
 (INCREASE BETWEEN 1977 TO 1982: \$ MILLION / % PERCENT)

INDUSTRY	A BUS.	B COMM.	C D/D	D EDPS.	E IND.	F INSTR.	G S/L	H SPEC.	TOTALS \$M/%
AGRICUL- TURE									
MINING					*				10/200
CONSTRUC- TION	***		**			*	**	*	130/260
MANUF., DISCRETE	**	*	***	*	**	*	*		1330/175
MANUF., PROCESS	**	*	***	*	**		*		1200/200
WHOLESALE DISTR.	***	*		*					340/350
RETAIL DISTR.	***	*		*					555/325
FINANCE	***	**		*					140/350
HEALTH	***	**		*			*		340/300
HOTELS	***								40/400
EDUCATION	***					*	*		150/170
INSURANCE	***	**		*					140/400
LEGAL / ACCTG.	***								20/400
TRANSPOR- TATION	***	**		*					200/260
UTILITIES	***	**	***	*	**			*	245/220
TOTALS	3100/ 310	385/ 180	150/ 300	285/ 130	412/ 160	110/ 100	366/ 150	42/ 100	4850/ 225

\*\*\* = GROWTH OF &gt;300%

\*\* = GROWTH OF 175-300%

\* = GROWTH OF &lt;175%



EXHIBIT III-9 (CONT'D.)

GROWTH MATRIX OF MINICOMPUTER AND SBC SYSTEM SHIPMENTS  
BY INDUSTRY AND APPLICATION - U.S./NON-GOVERNMENT  
(INCREASE BETWEEN 1977 TO 1982: \$ MILLION/PERCENT)

LEGEND

- A = GENERAL BUSINESS DATA PROCESSING
- B = COMMUNICATIONS
- C = DESIGN/DRAFT
- D = ELECTRONIC DATA PROCESSING SUPPORT
- E = INDUSTRIAL CONTROLS
- F = INSTRUCTIONAL
- G = SCIENTIFIC/LAB
- H = SPECIALIZED DATA ACQUISITION/CONTROL

- Three asterisks denote a market growth rate in excess of 300% from 1977 to 1982. Clearly, the general business data processing applications area is the fastest growth element transcending most industry segments.
- Additional areas of exceptionally high growth are positioned in the utilities and manufacturing industries for design/drafting applications.



#### IV DRIVING FORCES





#### IV DRIVING FORCES

INPUT perceives a variety of factors that impact the growth of the mini/micro-computer and SBC market over the next five years which also present a variety of potential new business opportunities. These driving forces run the gamut from economically induced factors (including the effects of inflation), to increased government regulation and control. Certainly of equal importance is the incessant march of technology which will continue to enable substantial cost/performance improvements in succeeding generations of hardware products.

##### A. MINIMUM WAGE INCREASES

- Increases in the minimum wage over the next five years will have particular impact on service industries having many clerical or unskilled hourly workers. Equal pay efforts affecting employers of female labor will also experience increased labor costs.
  - Industries particularly affected include:
    - . Insurance.
    - . Hotels.
    - . Health.
    - . Finance.
    - . Retail distribution.

## B. GOVERNMENT CONTROLS

- The probability is great that the government will create regulations requiring substantially more data concerning personnel, safety, energy utilization (actual and planned), tax information, export/import data (and perhaps forecasts), and other requests for information from every type of company. Therefore, company functional segments will create reporting demands without regard to or restraint by industry or application. Typical examples include:
  - Industrial relations and personnel.
  - Finance and accounting.
  - Plant management and maintenance.
  - International operations.

## C. INCENTIVES FOR CAPITAL SPENDING

- Unlike other traditional economic recoveries, expenditures for plant and equipment (which usually lag economic troughs by 9-12 months) have not recovered with the strength necessary to significantly aid in sustaining economic growth. Recent administration discussion regarding proposed tax incentives for industry include maintaining the investment tax credit rate while reducing the corporate income tax rate. Congressional approval would be viewed as a positive long-term factor with regard to the current issues. Furthermore, the trend toward the centralization of inventory and financial controls will continue as corporations further refine methods for asset management and investment.

#### D. COST OF COMMUNICATIONS

- Communications costs are not expected to substantially decrease over the next five years, while EDP network systems within all industry sectors are expected to accelerate their growth. This is in keeping with the growing trend to place intelligence where control functions are to be maintained or where most of the data to be manipulated is to eventually be used.
- Therefore, interactive terminals will lose the race to Distributed Data Processing (DDP) systems, and small computing nodes will proliferate. (Shipments of systems to a DDP environment in 1982, and requiring a significant communications capability, will approach 40%.)

#### E. THE MAINTENANCE ISSUE

- The general concern or fear of maintenance problems in far-flung corporate or divisional locations has been one of the largest deterrents to the explosive growth of DDP. The success of the late-coming IBM Series/I system emphasizes this fact. \*INPUT discovered that the most important reason voiced by users for selecting the Series/I was IBM's extensive maintenance capability. As users' trust in hardware increases and maintenance diagnostic techniques improve, the DDP network will proliferate and the users' concern for locating a system node in an out-of-the-way location will disappear.

\* "IBM Series/I: User Attitudes, Peripheral Opportunities, Product Plans and Competitive Impact," INPUT, September 1977.



## F. AVAILABILITY OF SKILLED PERSONNEL

- One of the principal often-voiced concerns that corporate entities articulate are the difficulties in attracting and holding skilled employees. We have no reason to suspect these problems will be alleviated in the future. Accordingly, demand will be spurred to the extent that intelligence based products can contribute to minimizing the requirement for skilled personnel, or improving the productivity of available personnel.

## G. TECHNOLOGY

- Technology will continue to drive hardware and software costs down yielding equipment capable of performing more tasks at a lower cost. Microcomputer system costs have been reduced by a factor of ten with a 95% component reduction over the last four years. This phenomenon has justified new applications for intelligence based products that were either not apparent or not economically feasible a short time ago. The increasing use of semiconductor technology, with its intrinsically higher reliability, has also significantly reduced mean times between failures (MTBF).

## H. \*THE MIGRATION OF SERVICE BUREAU USERS

- Service bureau customers are switching to SBC systems at an accelerating pace. "Lower cost" and "increased control" are the recurring reasons given by the defectors. The fact is that these users want their own SBC system and they often search for a logical reason to make the change. As the price/performance of SBCs increase, it will serve to accelerate the above migration.

\*"Small Business Computers: Their Impact on Processing Services", INPUT, April 1977.

V    IBM   AND   ITS   EFFECT   ON  
THE   MARKET



## V IBM AND ITS EFFECT ON THE MARKET

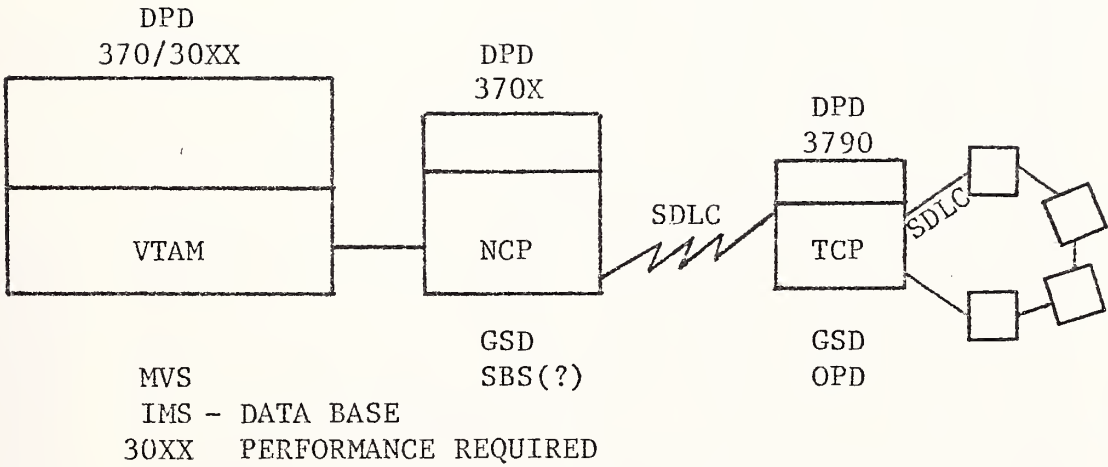
- No examination of the future market for intelligence based products in the mini/microcomputer class would be complete without recognition of IBM's role in this market as both a driving force and competitor.
- In this context it is appropriate to briefly identify IBM's major strengths and weaknesses. Its strengths include the following:
  - An outstanding ability to sell and service hardware through an extremely effective account control system.
  - A 60% share of market for general purpose central processors achieved through several generations of product families, e.g., 360, 370, 30XX.
  - An ability to defend its software investment through a combination of hardware, firmware, and related services strategies.
  - The huge resources that a \$20 billion corporate entity can bring to bear in the research, development, and marketing of new products.
  - Key areas of weakness include:
    - Communications related hardware, software and systems integration capabilities.
    - No minicomputer product offering (Series/I has obviously changed this situation).

- Limited data entry and terminal products.
  - The quality of software and related programming services.
- In an effort to redress these deficiencies, IBM has undertaken what INPUT regards as a multi-faceted "recovery" strategy which includes:
  - The introduction of the Series/I minicomputer.
  - Greater coordination between the Office Products Division (OPD), General Systems Division (GSD) and Data Processing Division (DPD) for eventual penetration of the consumer market. This includes small businesses in the next decade with the individual consumer later on.
  - SBS providing a capability permitting IBM to implement automated office computer/communications systems for its customers.
  - Development of its System Network Architecture (SNA) for distributed processing and predicated upon a flexible hardware/firmware/software strategy (see Exhibit V-1).
  - Improvements in data base management and manipulation.
- IBM entered the relatively well-established minicomputer market by virtue of its Series/I introduction in late 1976. Over the next five years INPUT is convinced that IBM will gain a major share of this market (see Exhibits V-2 and V-3) and will become a "first tier" competitor alongside DEC, Data General, and Hewlett-Packard.
- The Series/I, although an architecturally well designed product, offers no significant breakthrough in terms of performance features. IBM's product/market strategy largely adhered to traditional minicomputer practice and included the following elements:
  - Initial sales were targeted heavily toward OEMs with expectations for accelerating end user sales.



EXHIBIT V-1

IBM'S SYSTEMS NETWORK ARCHITECTURE



HARDWARE/FIRMWARE/SOFTWARE "FLEXIBILITY"

EXHIBIT V-2

FORECASTED NUMBER OF MINICOMPUTERS TO BE SHIPPED  
WORLDWIDE BY U.S. MANUFACTURERS

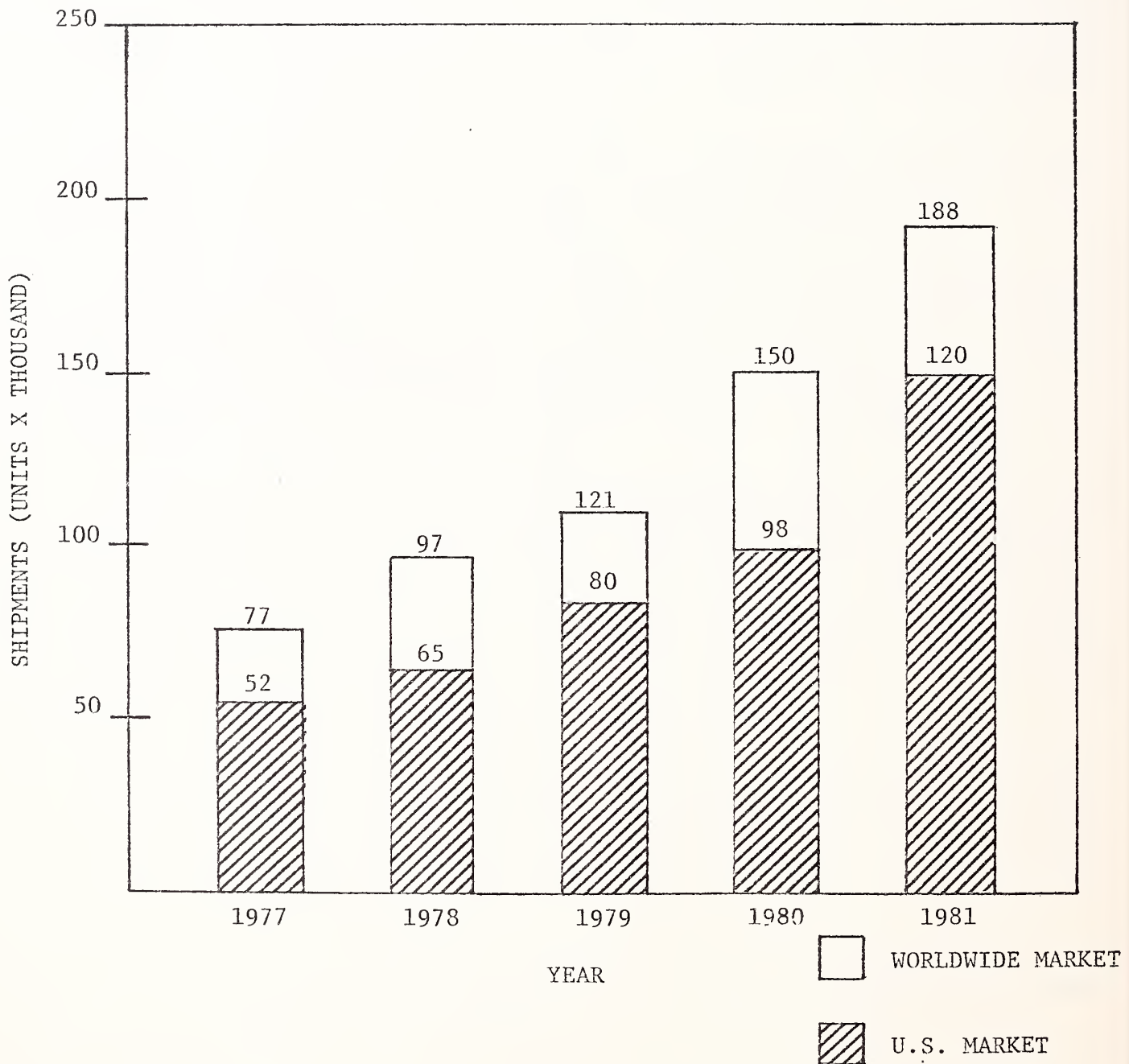
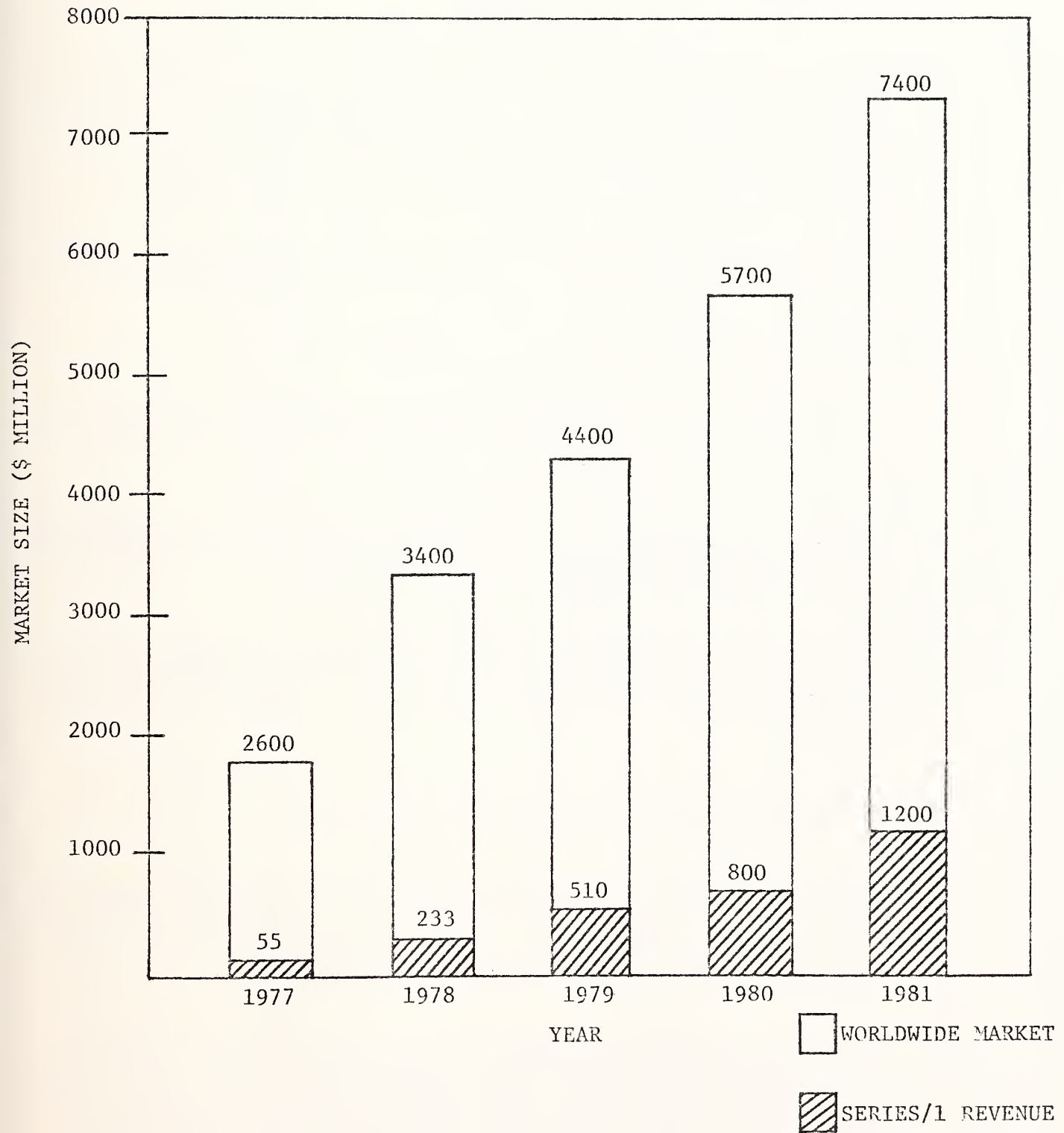


EXHIBIT V-3

IBM SERIES/1 GROWTH IN THE

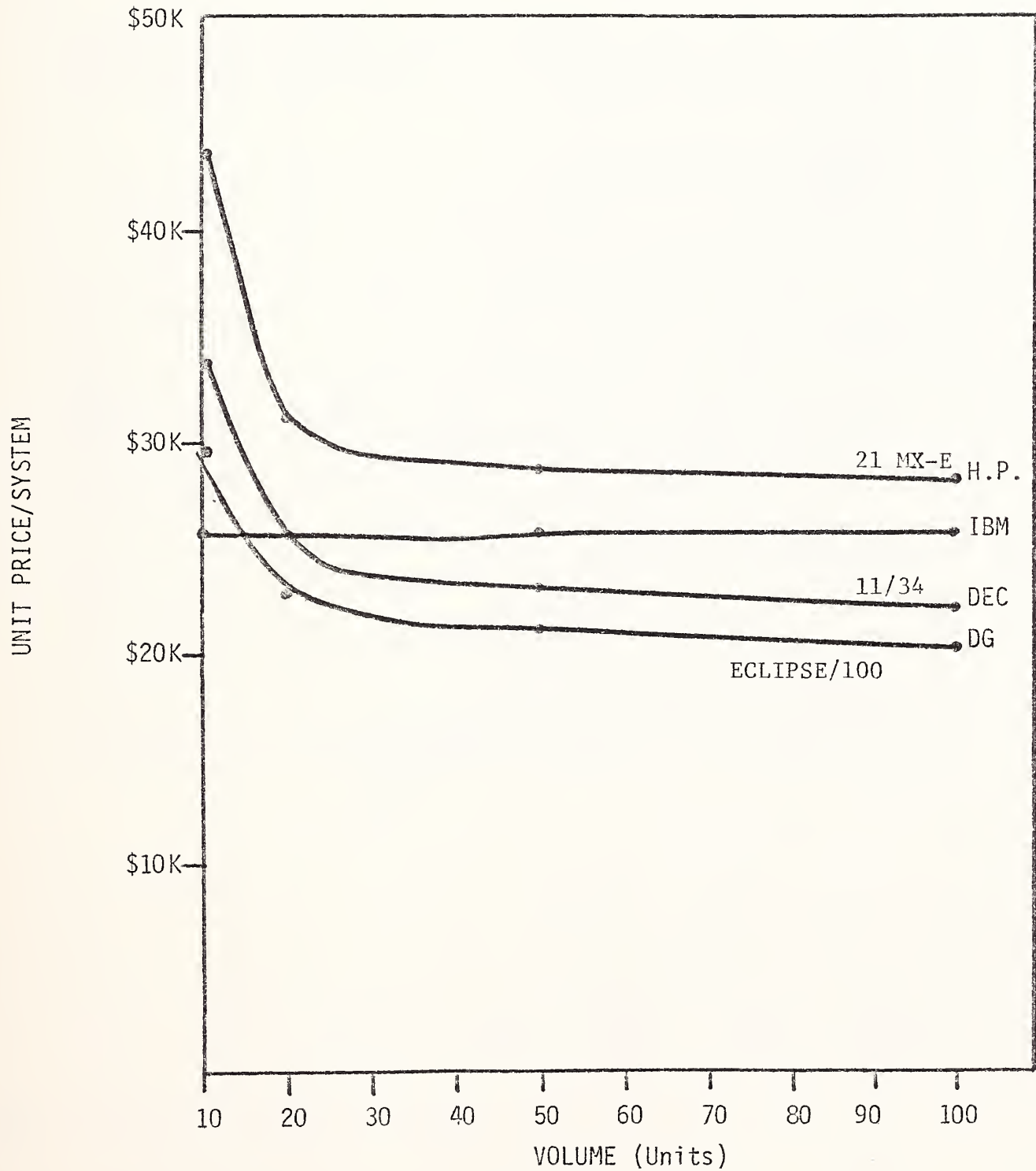
WORLDWIDE MINICOMPUTER MARKET



- Little software was initially made available.
  - The system architecture is extremely flexible and is capable of supporting as many as 256 peripheral devices.
  - Limited on-site support is available.
  - Pricing is extremely competitive for less than 40 units. Exhibit V-4 illustrates the price competitiveness of the Series/1 with similar product offerings from Hewlett-Packard, DEC, and Data General.
  - Outright purchase is required with no operating leases available (as yet).
- Several other factors are worthy of note including:
    - No volume discounts were offered which to this point in time appears to have worked well.
    - IBM offers the best field maintenance, service and support organization of any minicomputer supplier.
    - The IBM name alone will serve to lower the "buy" threshold for many businesses that are marginally interested in an SBC or minicomputer system.
- The impact on the market by the Series/1 is substantial:
    - Shipments will grow from \$55M in 1977 (2K units) to \$1,200M (37K units) in 1981, representing a 16% share of worldwide minicomputer shipments made by U.S. companies (see Exhibit V-5).
    - The market will "pull forward" about 8% by the presence of the Series/1 (see Exhibit V-6) in 1978. That is, IBM's market participation should increase the net dollar shipments of the minicomputer market by 8%.

EXHIBIT V-4

PRICE COMPARISON BASED ON VOLUME DISCOUNT SCHEDULES





## EXHIBIT V-5

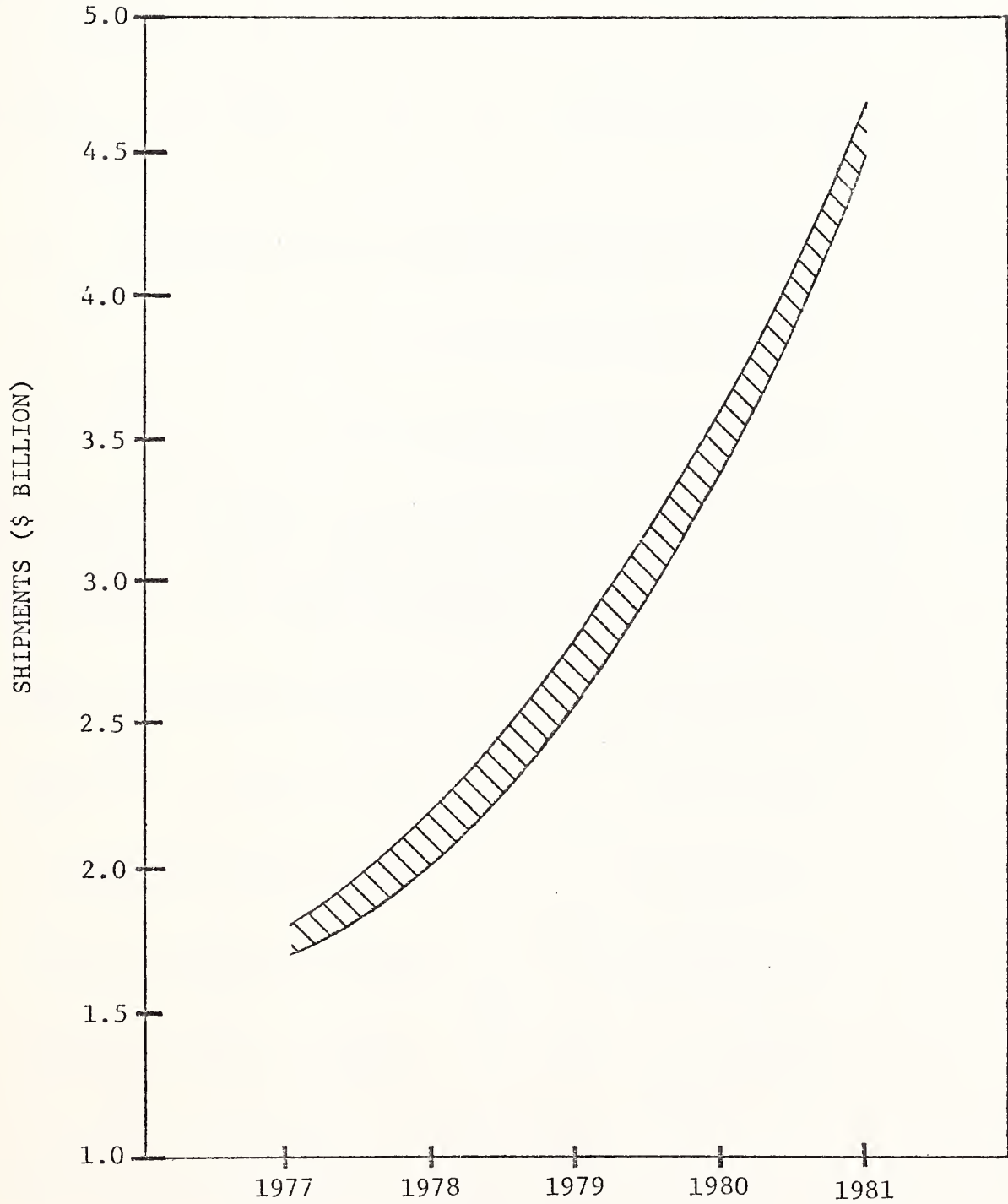
## SERIES/1 SHIPPING AND REVENUE

## FORECAST

	1977	1978	1979	1980	1981
A) SHIPMENTS (Thousands of units)					
--Annual	2	8	17	26	37
--Cumulative	2	10	27	53	90
B) REVENUE (\$ Million)					
--U.S.	38	160	310	450	600
--Worldwide	55	230	510	800	1200
--Worldwide (Cum)	55	285	795	1595	2795
C) % OF MARKET Worldwide	2%	7%	12%	14%	16%
D) AVERAGE PRICE/SYSTEM (\$ Thousands)	27.5	29.0	30.0	31.0	32.5

EXHIBIT V-6

FORECASTED U.S. MINICOMPUTER SHIPMENTS



 "PULLAHEAD" CREATED BY SERIES/1

- Although both the Series/1 and System 34 may expand the total market by approximately 10%, IBM's market share will be achieved largely at the expense of second tier suppliers. These lost opportunity sales will obviously serve to limit the relative rates of growth of these companies and contribute to driving the industry toward a more oligopolistic structure.

- Cumulative shipments will reach 90,000 units by 1981 (see Exhibit V-5) of which:

- Over 45% will be delivered to hardware integrators.
- Approximately 35% to end users.
- The remaining 20% to system houses.

- As shown in Exhibit V-7, the total Series/1 market for peripherals and main memories from all sources, including IBM, is about \$3 billion for the period 1977-81. The non-IBM plug compatible market portion is projected to be:

- Main memory: 30% of requirements, \$100M
- Disk drives: 20% of requirements, \$160M
- Tape drives: 20% of requirements, \$80M
- Line printers: 25% of requirements, \$110M
- CRTs: 40% of requirements, \$180M

EXHIBIT V-7

PROJECTED SERIES/1 PERIPHERALS AND MEMORY SHIPMENTS FROM ALL SOURCES  
(\$ MILLIONS)

PERIPHERAL	1977		1981		TOTAL 1977-1981	
	UNITS	\$	UNITS	\$	UNITS	\$
MAIN MEMORY	64M BYTES	\$ 5.6M	2,350M BYTES	\$111.M	5,750M BYTES	\$360.M
DISK DRIVES	2.0 K	17. M	37 K	370.M	90K	810.M
DISKETTE DRIVES	2.0 K	.5M	30 K	70.M	80K	150.M
TAPE DRIVES	.2 K	.7M	35.K	120.M	70K	245.M
PRINTERS, CHARACTER	2.0 K	5.6M	30.K	95.M	80K	240.M
PRINTERS, LINE	.2 K	2.5M	16K	200.M	36K	430.M
CRTS	3.2 K	5.5M	130 K	220.M	265K	450.M
SENSORS (ALL)	1.8 K	2.7M	33.K	65.M	81K	160.M





VI PRODUCT DISTRIBUTION  
TECHNIQUES



## VI PRODUCT DISTRIBUTION TECHNIQUES

### A. PRESENT METHODS OF DISTRIBUTION

- The minicomputer (or microcomputer), which is usually a major subsystem within the final product's architecture, is usually transparent to the end user. All small business computers, process and data control systems, specialized programmable terminals (banking, POS, text processing), problem solving equipment, industrial automation systems and communications processing equipment are marketed to the end user by a variety of distribution channels. (see Exhibit VI-1). Taken together, these various channels comprise a complex array of distribution alternatives.
- The end user may elect to either build his own system from OEM purchased components, or have installed a turnkey system ready for applications use:
  - The main advantages of a user building his own system are in the resultant price/performance advantages which can reach 20-30% for a small business computer system, or the more efficiently designed special purpose tool.
  - The requirements for buying micro or minicomputers, sensors, special/general purpose tools or equipment are often an inefficient utilization of a user's resources unless he is also able to provide unusual talents for systems or applications software support.

# EXHIBIT VI-1

## MINI/MICROCOMPUTER CONTROLLED SYSTEMS

### AS PERCENTAGE OF RETAIL PURCHASE PRICE:

	<u>MAKE OR BUY</u>	<u>SELLING PRICE</u>	<u>GROSS MARGIN</u>
OEM MANUFACTURER	30%	60%	50%
DISTRIBUTOR	60%	100%	40%
END USER	100%	N/A	N/A

- In the event that the user chooses to purchase an intelligence based turnkey system, he can do so either from the manufacturer or through a systems house. The latter supplier can usually provide a product offering with price/performance advantages and/or having a specialized applications software package.
  - For example, problem solving equipment or control systems will frequently include substantial added value from the systems supplier in the form of both additional hardware features and specialized software packages developed through joint specifications negotiations.
- Distribution methods change as software is replaced by firmware or hardware. As applications software installation problems are eliminated or greatly reduced, a tendency will develop to replace systems or software houses with electronics or components distribution.
- Another point worth noting in discussing distribution channels is the basic "make or buy" decision and whether as a result of this decision there remains adequate gross margin to support another "middleman" (see Exhibit VI-2):
  - For example, as the fully burdened cost of manufacture of an SBC system increases in proportion to the end user retail price, gross margin pressures increase on the distributor, systems house or other "middleman."

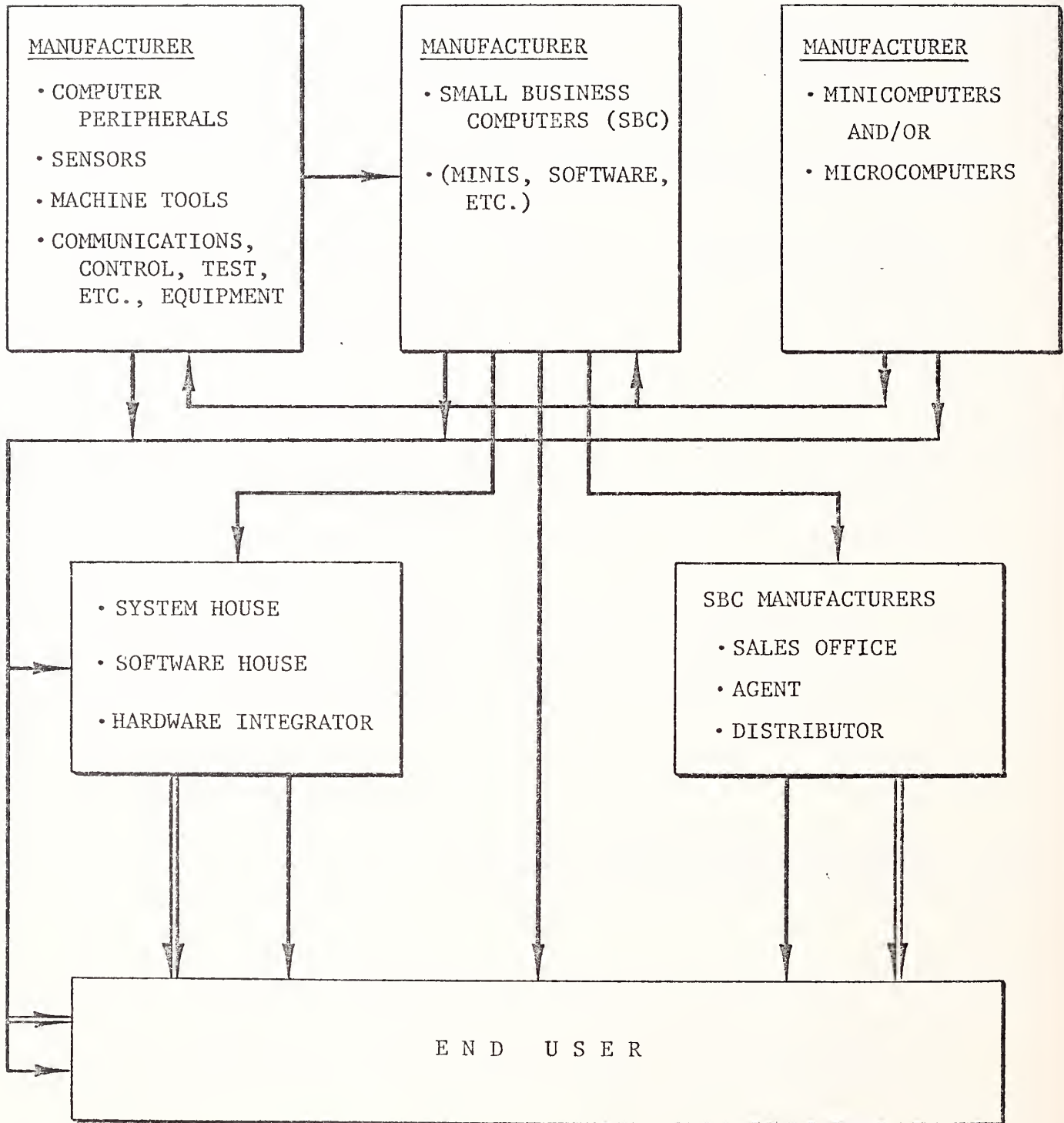
## B. FUTURE DISTRIBUTION TECHNIQUES

- As familiarity with the various capabilities of intelligence based systems increases, merchandising and distribution methods will change. Key factors that will contribute to creating changes in the methods of distribution include:



EXHIBIT VI-2

METHODS OF DISTRIBUTION:  
MINI/SBC SYSTEM DISTRIBUTION PATH



— OEM SALES  
== TURNKEY SALES

- A proliferation of applications.
- A drop in price. An extreme example of the preceding is the calculator which has dropped in price over the last ten years to such a significant degree that it now represents a commodity item.
- The reduction in importance of maintenance and service concerns as the reliability of products continue to improve. A corollary to this point is the reduction of customer or service engineers as a result of the simplicity of component product replacement.
- The replacement of highly trained and technically oriented sales personnel by manufacturers' representatives or in the extreme, clerks in retail outlets.



## VII INTERNATIONAL MARKETS





## VII INTERNATIONAL MARKETS

Although this study was scoped to consider only domestic markets, we think it appropriate to address a few key points.

- Approximately one-third of the current minicomputer market revenue base of U.S. manufacturers is derived from international sales; predominately from Western Europe.
- This relative percentage has been decreasing over the last 18 months as a result of a number of factors including:
  - Sluggishness in European economies.
  - DEC's international customers being on allocation as a result of capacity problems which have recently been relieved.
  - Reductions in minicomputer purchases by certain key European customers that have made up a disproportionate percentage of a company's revenue base.
- Small minicomputer manufacturers (sales less than \$100 million annually), who have averaged less than 20% of their sales from international sources, are now scrambling to develop a greater market presence in Europe. Strategies include acquisitions and direct investment in manufacturing and direct sales forces.

- The European minicomputer market appears to be less well developed than that within the U.S. and may offer a potential equal to or greater than the domestic market.
- The European microcomputer market is largely being served by U.S. technology which is being supplied either directly or through second source agreements.
- INPUT anticipates increasing merger and acquisition activity on the part of European suppliers within the U.S. in order to participate within the domestic economy/markets and to have easier access to U.S. technology.
- Joint distribution and marketing agreements between suitable multi-national companies may represent a viable means of participating within selected international markets.

VIII THE IMPACT OF TECHNOLOGY  
ON INTELLIGENCE BASED  
MARKETS



## VIII THE IMPACT OF TECHNOLOGY ON INTELLIGENCE BASED MARKETS

- The continued development of very large scale integrated (VLSI) circuits over the next decade will continue to drive the cost of memory and logic circuits down.
  - The quadrupling of memory density on a single chip of silicon every 2-3 years will continue into the next decade although the semiconductor industry will have to transition from traditional photolithographic manufacturing techniques to electron beam methods.
- As the above trend toward greater densities of memory continues to drive the cost per bit down, the economic incentives to program more efficiently will be reduced. This will serve to facilitate the use of higher level languages, increase the utilization of firmware within equipment architecture and continue to make these systems transparent to the end user.
- Traditional semiconductor component companies will accelerate their forward integration strategies toward EDP markets leveraging their technological strengths in entering high volume/low average selling price types of system markets.
  - Texas Instruments, which is at the leading edge in the commercial development of bubble memories and charge coupled devices (CCD), must be expected to use these products to further their longer term goals in the distributed data processing market.



- Microprocessors, which first emerged in 1971, have spawned complete families of four and eight bit microcomputer products used in consumer, industrial and computer related applications.
- Significant development work continues in an effort to achieve higher levels of microcomputer system integration on a chip of silicon. These efforts will see the introduction in 1978 of 16 bit microcomputer systems which will become increasingly more powerful over the next several years. These machines will be targeted for major applications usage in computer and telecommunications related applications. Furthermore, as a function of speed improvements in MOS technology, these 16 bit microcomputers may significantly change the traditional architecture and methods of manufacture of minicomputer based products.

## IX COMPETITIVE ANALYSIS



## IX COMPETITIVE ANALYSIS

- The minicomputer and SBC competitive environments are populated by 100 or more firms which for purposes of this study we arbitrarily divided into three tiers as follows:
  - The top tier of companies deriving \$300 million or more per year from the above markets include IBM, DEC, Hewlett-Packard, and Data General.
  - A second tier of companies with revenues in the \$100-\$300 million range which is limited to Texas Instruments and Honeywell.
  - All others with sales below \$100 million.
- By virtue of a number of the driving forces already discussed in this report, and aided by an accelerating trend to mergers and acquisitions, the referenced market is expected to be dominated by an oligopoly in the post-1980 time frame.
- Significant potential new market entrants over the next 3-5 years include such traditional semiconductor companies as:
  - Texas Instruments with currently less than a 5% share of the minicomputer market.

- Intel with what is currently estimated to be a 50% share of the microcomputer market .
- National Semiconductor which may be preparing to enter the mini-computer market through an emulation strategy similar to its relatively successful mainframe program with Itel Corporation.

● Battlelines are now being drawn in two major minicomputer markets. These include:

- The high end portion of the market which is rapidly blurring with the 370/115 through 370/148 class of machines. DEC by virtue of its recent 32 bit product offering, which we believe will be shortly joined by a Data General 32 bit machine, is increasingly challenging the mainframe market. National could conceivably participate in this area with a stripped version of its advanced system mainframe.
- The low end with microcomputers supplied by DEC, Data General, Computer Automation, Intel, and Texas Instruments.

● A consensus is forming with regard to the longer term intentions that the Japanese may have in the worldwide EDP market. It is our contention that in the short term the Japanese will seek SBC market presence and visibility in the United States by means of joint marketing and manufacturing agreements.

- The Itel/Hitachi arrangement, whereby the Japanese company will supply emulated IBM 3032's which will be marketed by Itel, is an illustration of the above point.



## X OPPORTUNITY SCENARIOS



## X OPPORTUNITY SCENARIOS

In the course of researching and documenting the preceding study, a number of market and product opportunities were uncovered or conceptualized by INPUT. These are briefly summarized below.

- It is INPUT's contention that the concern regarding human resources and their utilization, coupled with government regulation and attendant reporting requirements, will continue to be an increasingly important subject of corporate concern. The driving forces behind this area of opportunity include:
  - Equal opportunity considerations for minority and "disenfranchised" elements within our society.
  - Increased liability and job safety concerns brought about by government regulation with concomitant escalation of medical and insurance demands.
  - Issues related to retirement and pension programs including their funding and the necessary safeguards to insure the viability of these plans.
- Consequently, INPUT suggests examining a hardware/software product keyed to the above personnel related issues. We euphemistically refer to the above product as a "personnel engine" which effectively transcends industry barriers

and is external to the traditional domain of the data processing manager. Indeed the buyer of such a product offering would be the corporate industrial relations department.

- A second opportunity scenario offers itself in the form of the maintenance and diagnostic requirements presented by the increasingly more complex array of EDP systems. Although in an absolute sense such equipment may be achieving higher levels of reliability, they nonetheless do experience failures and downtime. Conceivably then a communications aided diagnostic capability for purposes of fault determination and card or component replacement may be postulated. Such a product could also provide shipping instructions while adjusting the inventory level of the component/product in question. In this instance, the buyer would be the manufacturer or end user of the equipment to be diagnosed.
- INPUT regards the market for minicomputer-based interactive design systems, as employed for computer-aided design (CAD), as a favorable business opportunity. The main driving forces are the fundamental need to improve productivity in design and drafting operations in the face of a shortage in highly skilled (and paid) draftsmen. Applications include printed circuit board layout, integrated circuit and hybrid circuit mask layouts as well as other applications in the construction and manufacturing industries. Software is the key in this area and any new product offering might consider adding a metric conversion feature to accommodate the U.S. shift to this standard over the next decades.
- Finally, it seems appropriate to touch upon several market areas that are intimately familiar to TRW, i.e., the possibilities offered by its participation in the retail, credit checking and banking business. Conceivably, a network linking all three of the above markets and functions offers the prospect of a major credit resource. As such, a network of this type may have significant appeal in any future electronic funds transfer system that may be forthcoming.

## APPENDIX I: DEFINITIONS





## APPENDIX I:        DEFINITIONS

- A Small Business Computer, for the purpose of this study, is a system which is built around a Central Processing Unit (CPU), and which has the ability of utilizing at least 20 M bytes of disk capacity, provides multiple CRT work stations, and offers business-oriented system software support.
- A Small Business Computer Manufacturer builds its system around a proprietary CPU and provides systems software. It may make or buy peripheral equipment and semiconductor devices. Distribution to the end user may be through its company field sales offices, a network of distributors, or both.
- Software Products are systems and applications packages which are sold to computer users by equipment manufacturers, independent vendors, and others. They also include fees for work performed by the vendor to implement a package at the user's site.
- A Systems House integrates hardware and software into a total turnkey system to satisfy the data processing requirements of the end user. He may also develop system software products for license to end users.
- A Distributor purchases the small business computer on an OEM basis from the manufacturer and markets it to the end user. It may or may not provide a turnkey system.

- Peripherals include all input, output, and storage devices, other than main memory, which are locally connected to the main processor and are not generally included in other categories, such as terminals.
- A Turnkey System is composed of hardware and software integrated into a total system designed to completely fulfill the processing requirements of a single application.
- An End User may buy a system from the hardware supplier(s) and do his own programming, interfacing and installation. Alternately, he may buy a turnkey system from a systems house or hardware integrator.
- A Hardware Integrator develops system interface electronics and controllers for the CPU, sensors, peripherals and all other ancillary hardware components. He may also develop control system software in addition to installing the entire system at the end user site.
- A Microcomputer combines all of the CPU, memory and peripheral functions of a computer on a chip of silicon. It may be sold in an integrated circuit package or with the addition of more memory and peripheral circuits packaged on a board or in a console.
- A Minicomputer is usually a 12 or 16 bit computer which is provided with limited application software and support and represents a portion of a complete large system.





